Abdominal circumference ratio for the diagnosis of intertwin birth weight discordance

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Abstract

Objectives: We assessed the accuracy of predicting severe twin birth weight discordance (>25%) using the estimated fetal weights (EFW) and abdominal circumference (AC) ratio.

Method: A cohort of twin gestations underwent ultrasound examinations within two weeks from birth. We focused on the accuracy of EFW and on the diagnosis of severe birth weight discordance by the difference in EFWs and the AC ratio.

Results: The 661 eligible twin pairs included 51 (7.7%) severely discordant pairs. The accuracy of an EFW to predict the actual birth weight was quite poor, with an acceptable specificity (96.4%), but low sensitivity (28.6–40.5%), to detect severely discordant pairs, whereas an AC ratio of 1.3 detected these discordant pairs with sensitivity and specificity of 97.3–100% and 99.6–99.7%, respectively.

Conclusion: By comparing EFWs, 59.5–71.4% of discordant pairs >25% are missed, whereas an AC ratio >1.3 would identify almost all cases.

Keywords: Abdominal circumference ratio; birth weight discordance; estimated fetal weight; twins; ultrasound.

Introduction

The prenatal diagnosis of growth discordant twins was attempted since the early days of ultrasonography. For example, in 1977 Houlton compared the biparietal diameters (BPD) in 28 pairs and was able to detect divergent growth in 61% of the pairs [13]. In the following three decades, during which the clinical implications of discordant growth of twins has been clarified [3], fetal weight discordance became an integral part of the prenatal assessment of twins. These attempts are apparent from hundreds of studies trying to establish the accuracy of sonographic prediction of birth weight discordance. At present, the best estimate of discordant growth comes from calculating paired estimated fetal weights (EFWs) and deriving the discordance level by the same way it is derived from actual birth weights [5]. At the same time, however, it became clear that even with a relatively accurate EFW (within ±10% of the actual birth weight) calculated for each fetus, the "±" situation may involve significant error in estimating birth weight discordance with both "diverging" and "converging" estimations.

Over the years, two more related issues became apparent [4]. First, that lower levels of birth weight discordance probably represent an intertwin natural variation and that the level likely to represent aberrant growth is at least 25% [8]. Second, that as many as 40% of severely discordant twins (i.e., birth weight discordance > 25%) do not represent significant growth restriction because the smaller twin is not small-for-gestational age (SGA, birth weight < 10th percentile for gestational age) [1, 6]. It follows that once discordant growth is suspected, one should differentiate between the "normal" and the "abnormal" (i.e., with and without the smaller twin being SGA) severely discordant pairs. Currently, there are no data to show how accurate are sonographic measurements in identifying these abnormally discordant pairs.

One way to reduce the inherent method error of estimating intertwin discordance was to compare the abdominal circumference (AC). In the mid-80s several AC differences were suggested as adjuncts to the EFW difference to detect discordant twin growth [7, 15]. However, the absolute AC difference seems to be gestational age dependant and, therefore, could not significantly improve the accuracy of estimating birth weight discordance [9]. More recently, a Canadian study [14] calculated the AC ratio in a cohort of diamniotic twin gestations. A total of 64 pregnancies (12.7%) had discordant birth weights > 25% and an AC ratio cut-off of 0.93 yielded a sensitivity and specificity of 61% and 84%, respectively.

In the present study, we assessed the accuracy of the AC ratio and the EFW difference in predicting discordant twins, and in differentiating discordant pairs in which the smaller twin was or was not SGA.

Methods

This is a study of sonographic measurements in twins prospectively collected between January 1, 1994 and June 30, 2008 in the tertiary maternity center Alfredo da Costa, Lisbon, Portugal. During this period, information about the pregnancy and delivery was prospectively registered on a preset form and subsequently entered into a computerized system. We included in the present assessment all
twin gestations irrespective of choriocitcity, in which paired sono-
graphic measurements were performed within two weeks before
birth and both twins were born alive at our hospital. All other pairs
were excluded. During this period, we used several ultrasound
machines, but the measurements were performed by the same stan-
dardized method and by the same operators (Portuguese authors).
EFW was calculated automatically by the sonographic machine
using the ASTRAIA software (Astraia software GmbH, Munich,
Germany) and the inbuilt formula of Hadlock (based on AC and
femur length). The AC was measured at the level of the bifurca-
tion of the main portal vein, taking care of depicting as round a section
as possible. Measurements of each parameter were done three times
and the average was used for calculations. In this study, the AC was
the presenting twin.

This study focused on three questions. (1) The accuracy of EFW as
compared to the actual birth weight for each of the twins. We
defined an accurate EFW as one within ±10% of the actual birth
weight, and calculated the frequency of an EFW exceeding this
value. (2) The predictive values of the difference in EFWs to estab-
lish an accurate diagnosis of severe (>25%) birth weight discord-
ance. (3) The accuracy of the AC ratio (AC of larger twin/AC of
smaller twin) in predicting birth weight discordance. We evaluated
three ratios: >10% difference (ratio < 1.1), >20% difference (ratio
of 1.2), >30% difference (ratio of 1.3). The primary hypothesis
was that the AC ratio might be a better predictor of severe
discordance.

Discordance level was calculated from the difference between
EFWs or birth weights divided by the EFW or birth weight of
the larger twin and expressed as a percentage. The severely discordant
pairs were further subdivided into pairs in which the smaller twin
was either SGA (SGA discordant) or not SGA [appropriate-for-gesta-
tional age (AGA) discordant]. SGA status was calculated from
Portuguese twin birth weights by gestational age charts (unpub-
lished). The study was approved by the local Institutional Review
Board.

We used the True EPISAT8 Software (Math Archives, Round
Rock, TX, USA) to compare frequencies by the Fisher's exact. We
derived odds ratio (OR) and Corenfield's 95% confidence inter-
vals (CI). Continuous variables were compared by Student's t-test, with
P-value < 0.05 considered significant. Sensitivity was calculated
from the number of true positive values divided by the sum of true
positive plus false negative values, whereas specificity was cal-
culated from the number of true negatives divided by the sum of
true negative and false positive values.

Results

The results from 661 twin pairs were eligible for the study,
comprising 610 concordant (<25%) and 51 (7.7%) severely
discordant pairs. Table 1 shows that pregnancies with con-
cordant pairs had similar characteristics compared to preg-
nancies with AGA discordant twins. In contrast, SGA
discordant pairs had a significantly lower (P < 0.05) mean
maternal age, mean gestational age of last sonography, and
mean gestational age at birth compared to both concordant
and AGA discordant pairs.

Table 2 shows that the accuracy of an EFW to predict the
actual birth weight was poor for twin A with significantly
more AGA discordant twins being wrongly estimated
(>10% of actual birth weight) compared to the other two
groups. These values were somewhat better for twin B with
about 50% accurate EFWs in all three groups. Whereas the
specificity was quite good to detect both groups of discordant
pairs, the sensitivity was quite low.

Table 3 shows the accuracy of the three AC ratios in pre-
dicting discordance. It appears that almost half of the con-
cordant twins have at least a 10% difference (AC ratio of
1.1). When a higher cut-off value was chosen (i.e., ratio
of 1.2 and 1.3), both sensitivity and specificity reached nearly
100%.

Discussion

The prediction of intertwin birth weight discordance by
sonography has been extensively studied [5]. Discordance,
especially if severe, seems to be a trigger for looking at
growth aberration of the twins, and in particular, growth
restriction of the smaller twin. Very different predictive
results can be found among the numerous papers, but the
overall impression is that prediction of discordant growth by
comparing EFWs is not accurate for clinical use [4, 5]. This
statement is based on two observations. First, probably
because of fetal crowding in twin gestations, it seems more
difficult to obtain an accurate EFW for an individual twin
compared with singletons [12]. This observation was sup-
ported by our study (Table 2). Second, even with accurate
EFWs (i.e., within ±10% from the actual birth weight) it is
inherently difficult to obtain an accurate discordance level.

The decade-old conclusion reached in the review of Car-
vello and co-workers, is still relevant today: most popular
methods (difference in AC or EFW) for predicting discordant
growth in twin gestations have limited accuracy for discon-
Table 2  Estimated fetal weight (EFW) difference in predicting birth weight discordance.

<table>
<thead>
<tr>
<th></th>
<th>Concordant (n=610)</th>
<th>Discordant (&gt;25%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGA (n=14)</td>
<td>SGA (n=37)</td>
</tr>
<tr>
<td>EPW, twin A (g)</td>
<td>2104±486</td>
<td>2168±314</td>
</tr>
<tr>
<td>Birth weight, twin A (g)</td>
<td>2236±466</td>
<td>2282±545</td>
</tr>
<tr>
<td>Accurate EFW (&lt;10% error)</td>
<td>3106±610 (50.8)%</td>
<td>2104±483</td>
</tr>
<tr>
<td>EPW, twin B (g)</td>
<td>2274±470</td>
<td>2328±401</td>
</tr>
<tr>
<td>Birth weight, twin B (g)</td>
<td>3306±610 (54.1)</td>
<td>2274±470</td>
</tr>
<tr>
<td>Estimated discordance &lt;25%</td>
<td>598 (96.4)</td>
<td>614 (42.8)</td>
</tr>
<tr>
<td>Estimated discordance &gt;25%</td>
<td>True negative, 22</td>
<td>True positive, 15</td>
</tr>
<tr>
<td>Sensitivity (%)</td>
<td>26.6</td>
<td>28.6</td>
</tr>
<tr>
<td>Specificity (%)</td>
<td>96.4</td>
<td>96.4</td>
</tr>
</tbody>
</table>

Data presented as n (%) and as mean±standard deviation. Predictive values were calculated by separate comparisons of AGA and SGA discordant to concordant twins.

*OR 0.2, 95% CI 0.04, 0.8.

*OR 0.1, 95% CI 0.01, 0.8.

AGA = appropriate-for-gestational age, SGA = small-for-gestational age, OR = odds ratio, CI = confidence interval.

dance level of at least 25% [10]. It is, therefore, necessary to find ancillary means to improve the prediction of discordance.

In our sample of twins a ratio of 1.3 between paired ACs predicts severe birth weight discordance with very high sensitivity and specificity values. Our cut-off AC ratio is different than that proposed by Klam et al. [14], but we obtained much higher sensitivity and specificity values compared to those found by these authors. Moreover, this ratio was as good in predicting severely discordant pairs with and without an SGA smaller twin. Thus, although this ratio is an excellent predictor of severe discordance, it cannot differentiate between the two entities.

One limitation of our study is the low frequency of severe discordance (7.7%). This value, however, is in accord with the frequencies found in nearly 125,000 American twin pairs [5] but reduces the power of the analysis. On the other hand, our study is among the largest of its kind, and comes from a single center, with a protocol of ultrasound assessment that did not change over time.

Another limitation of our study, as in most other studies, is that all methods for estimating discordance are in fact capturing the situation at a stage within one to two weeks from birth. Such methods, in fact, do not predict severe discordance but rather diagnose it before birth. Attempts to predict discordance by ultrasound measurements of fetal growth velocity and size during the early weeks of the third trimester were poor predictors of birth weight discordance [2, 11]. Although Hadlock's formula using the femur length and AC might underestimate the true birth weight, it is expected to do so for both twins and thus unlikely to reduce the accuracy of estimated discordance.

The question may arise if such a diagnosis is not reached too late, and hence there is need to assess the ability of the AC ratio obtained in the early third trimester to predict the subsequent development of severe discordance. It is also possible that fetuses may continue to grow in the last two weeks before birth and therefore reduce the accuracy of predicting discordance. However, we feel it is unlikely that a difference generated within the last two weeks will cause severe discordance in mildly discordant twins or would mistakenly consider one twin as SGA. Using the extremes (severe discordance and being SGA) may decrease the potential methodological inaccuracy. Because we used the last sonographic measurement, we were unable to count how many pairs were close to but less than 25% discordance at two weeks before birth but were discordant at birth. Thus, counting them as false negative cases might be incorrect given the potential for a true diagnosis had another measurement been done.

Regardless of these reservations, our data suggest that with the current method of comparing EFWs, 60–70% of severely discordant pairs are missed, whereas the finding of an AC ratio > 1.3 would identify almost all cases.